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INTER-OFFICE CORRESPONDENCE

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From: MJ Mann/SA Roberts

Subject: Waukegan North Ditch

1. To prepare for testimony on PCB remedial actions on Waukegan, we were asked to look at three aspects of the situation. Those were:

   a. Do previous estimates for surface water discharge from the North Ditch to the lake consider only sediment transport or do they include a soluble component as well? yes

   b. Does the soluble PCB adsorb and then settle? Modeled - will adsorb and settle.

   c. What is the estimated effect of filling the North Ditch? - benefit.

2. The following reports were reviewed:

   - EPA Overview Report - wk 1.100
   - Draft EIS dated November 4, 1981
   - Math Modeling Estimate of Environmental Exposure Due to PCB-Contaminated Harbor Sediments of Waukegan Harbor and North Ditch, prepared by HydroQual dated February 1981
   - An Engineering Study for the Removal and Disposition of PCB Contamination in the Waukegan Harbor and North Ditch, prepared by Mason-Hanger dated January 1981
   - Hydrological Study of Groundwater, JRB Associates dated February 10, 1981.

3. After perusing the reports, it was found that the HydroQual report does consider the dissolved and particulate components of the total PCB discharge in both the Harbor and North Ditch areas. (page 42)

   The relationship between particulate and dissolved portions is shown by:

   $$C_D = C_T \left(\frac{1}{1 + am} \right)$$ ..... p. 44-45 of HydroQual

   where C_D = Dissolved PCB (ug/l)
   C_T = Total PCB (ug/l)
   m^T = SS (g/l)
   a = Partion coefficient. Used as 50-500 ug/g per ug/l based on Hudson River studies by Hydroscience.

   Running this through we find that the C_D may range from 2-17% based on a nominal ditch SS concentration of 100 mg/l.

Thus, based on HydroQual's estimate of 5kg per year of PCB discharged through the North Ditch to the lake, we may expect a maximum of 1kg to represent the dissolved PCB portion.

The dissolved portion is being discharged through two major mechanisms: solubilization of material in the ditch by surface waters and groundwater discharge through the ditch of solubilized material. We cannot estimate that split at this time.

The JRB report (p.65-70) indicated that at times (Type I Flow) the groundwater contaminated from the western enclave flows directly to the North Ditch. However, the extent and total loading on an annual basis have not been estimated.

4. The solubilized PCB will adsorb on appropriate sites down to solubility concentrations for the specific brand of Archlor. However, there are some important variables that modify this function. These were pointed out by SA Roberts memo of 7/21/82. PCB's are infinitely soluble in hydrocarbon and chlorinated solvents and "desorb" completely in the presence of non-polar solvents. There is some evidence that such solvents may be present on the site. Also, it is known that PCBs can move in ground water while adsorbed onto colloidal material.

5. Summary of North Ditch Discharge Estimates

Component	Mason-Hanger Final Report	HydroQual	JRB	Draft EIS	EPA Overview
Sediment	1-10 lb/yr	4 Kg/yr (8.8 lb/yr)	Ground water only	Appendix C not available	
Soluble	4 lb/yr (Base + Cooling water)[a] +6 lb/yr (storm flow)	1 Kg/yr (2.2 lb/yr)			
NET	11-20 lb/yr	11 lb/yr[b]	-	-	7-8 lb/yr[c]

(a) Ave ditch flow = 100,000 gpd
OMC cooling water flow = 150,000 gpd
Ave conc = 5-8 ppb

(b) Ave ditch conc Total PCB = 9.25 ppb

(c) EPA states "there is the possibility that, under special conditions, large additional releases may occur."

6. The big question coming out of this discussion is "will the filling of the North Ditch actually make the problem worse in terms of total PCB material discharged to the lake?"

Our conclusion is that, no, the situation will not be worse in terms of total PCB release. This is supported by the facts that:

a. Three phases can be expected in the overall equilibration of the discharge area. Phase 1: 0-30 year time frame. This period is from the filling of the ditch up until the first expected impact of the eastern enclave. Phase 2: 30-100 year time frame will see the complete migration and end of the eastern enclave. Phase 3: 300-500 year, the western enclave will reach the lake and eventually diffuse. This is based on the JRB work using Darcy velocity modelling neglecting porosity. (Draft EIS p. 1-27)

b. Particulate material discharged from the ditch will cease. For the next 30 years, (until the eastern enclave migration intersects the lake) PCB material release will be negligible.

c. The installation of a properly designed storm water interceptor will minimize ground water recharge and should slow the horizontal migration component.

d. Paving of the entire area will also minimize this recharge.

e. Adsorption will occur in the area between the eastern and western enclaves of PCB concentration, acting to mitigate overall discharges. This does not occur when contaminated groundwater flows directly into the North Ditch.

The major question is the net impact of the modification of groundwater flow directions within the area. However, we have calculated that even if the western enclave would contribute to the direct discharge the total quantity would not exceed 5kg. This estimate assumes no adsorption through the site. The calculations are summarized in 7.

7. PCB Loading Rates from the western enclave after filling North Ditch

The ground-water discharge was first calculated, using the Darcy Equation:

$$Q = KIA$$

- K = hydraulic conductivity; two values were used:
  - 1×10^{-3} cm/sec - slower rate
  - 6×10^{-3} cm/sec - faster rate

These values are taken from the JRB report (p. 3-42); they represent the upper and lower limits on the mean baildown permeabilities, calculated from field measurements.

- I = hydraulic gradient; a value of 0.001 ft/ft was used; this is a typical value for a low gradient and is similar to values calculated from actual head values on-site.

- A = cross-sectional area; the values used were:

    - 1000 ft. - width of aquifer from ditch to middle of parking lot (assumed to be topographic high)
    - 25 ft. - depth to silt layer, based on values in JRB report (p. 3-24)

$Q(slow) = 71\ ft^3/day$

$Q(fast) = 425\ ft^3/day$

(conversion factor used = 2835.36)

The PCB loading rates were then calculated using a PCB ground-water concentration of 1000 ug/l. This is taken from the maximum PCB concentration that appears to be at least somewhat mobile in the aquifer. The loading rate was calculated using the following equation.

PCB concentration (g/l) x 0.062427 (conversion factor) x Q (cfd) = PCB lbs/day

Low PCB loading = 1.8 grams/day or 0.004 lbs/day
High PCB loading = 13.6 grams/day or 0.03 lbs/day

The limitations of available data preclude establishing the extent of time when flow is toward the lake and therefore an estimate of annual loadings from the western enclave is not possible at this time.